

Representation as Communication: Fields

Directions: This sheet will be collected. Write your name at the top of every page. Follow your instructor's directions. It will not be graded, so write whatever you wish.

1. Gravity. Suppose you hold a 1-pound weight in front of you at waist height. Then you put that down and pick up a 2-pound weight, holding it at waist height in front of you. In what sense is gravity the same in these two cases and in what sense is it different?

A. Representation: Symbols. Suppose that on earth you weigh 100 pounds and your friend weighs 200 pounds. Suppose your friend (use your imagination) moves away to a planet where he now weighs 50 pounds

(a) Do you have to visit that planet to know how much you'd weigh there? Why or why not? How could you tell someone concisely how they could figure out what their weight on that planet would be?

(b) If you had to choose a number to communicate the strength of gravity on the surface of planet X, what number would you choose? Why?

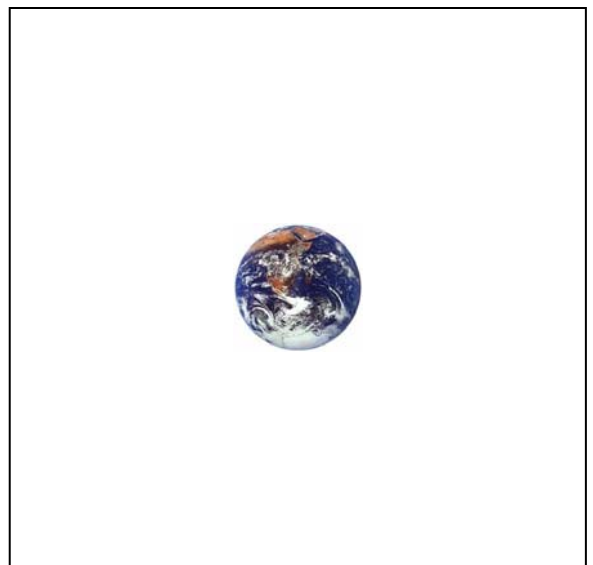
(c) Can you choose a single number that specifies the gravitational *force* felt at surface of planet X? Explain.

(d) Express the relationship between all the masses and forces for the two cases symbolically as an equation.

B. Representation: Visual. Here's a picture of the Earth. Invent a way of "drawing" the gravitational field around the Earth. At any given point, your representation should show the direction of the field and also its strength. Where is the field stronger? Weaker?

Try to find someone whose representation of the field is different from yours. Discuss whether or not each of your representations can successfully communicate to the other person the strength and direction of the field.

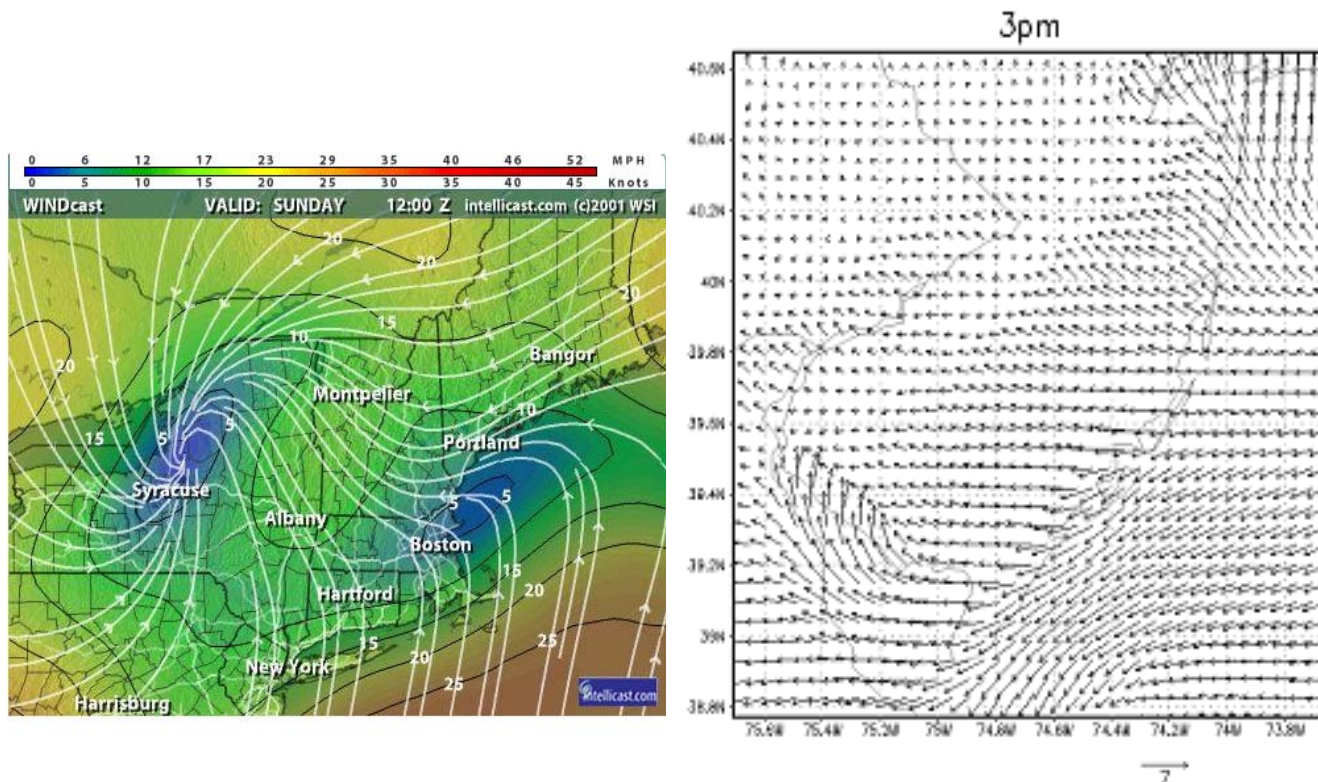
2. Air Flow. In tutorial this week, you consider the issue of kites of different sizes placed in a wind. Here, we will consider a variety of ways to represent the flow of the wind.



ILD 10: Fields

A. Representation: Hurricane. A wind sock will orient itself parallel to the wind's direction and at an angle that indicates the wind speed. Obtain a red paper "wind sock" and follow your instructor's directions.

B. Representation: Weather Maps. In the two figures below are shown two different representations used by meteorologists (taken from the web) to indicate wind speed and direction across an area.



How are direction and magnitude indicated on these two maps?

In what ways is the first map better? In what ways is the second map better?

3. Electric Fields. In lecture we have introduced the idea of electric field. The electric field at a point is measured at a point by looking at the force a test charge would feel if placed at that point. We then divide by the value of the test charge to take out the effect of the "measuring instrument." Symbolically we write this

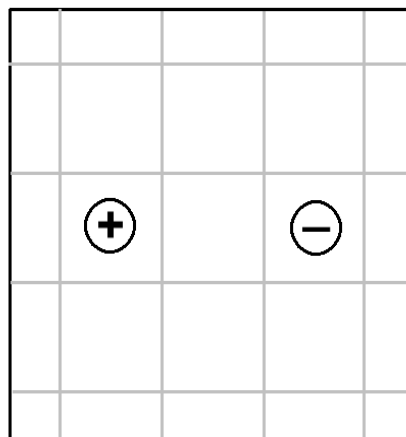
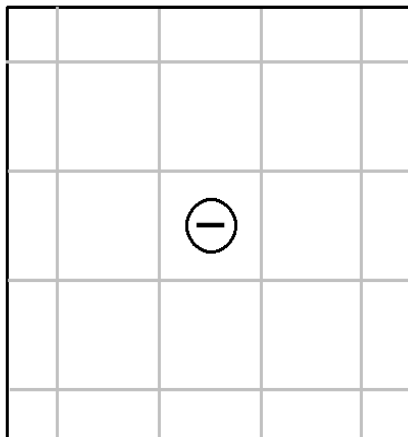
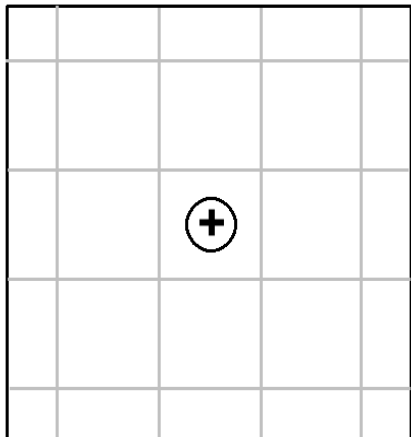
$$\vec{E}(\vec{r}) = \frac{\vec{F}_{\text{felt by } q}}{q} \quad (\text{test charge } q \text{ placed at } \vec{r})$$

ILD 10: Fields

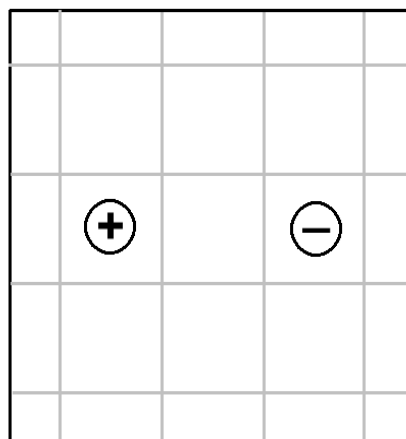
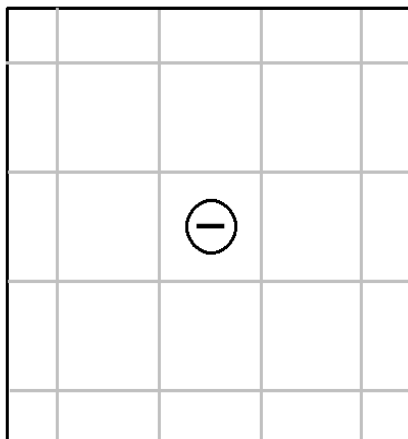
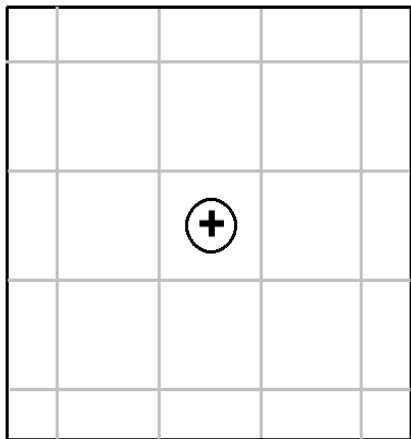
A. Representations

Consider three cases: a single positive point charge, a single negative point charge, and a dipole (a pair of charges, one positive, one negative).

In the three boxes below, sketch the direction and relative magnitude of the electric force that a test charge would feel if placed at each gridpoint in the box. When you are done, compare your results with your neighbor's in preparation for a class discussion.



On the grids below create a representation of the electric field in the region of each box that would communicate to someone looking at it what a test charge would feel if placed at any point in the region.



B. Using the Representation. If there is time, go through an exercise using test charges to probe the location of a set of source charges. (Display computer program.)

Where do you think the charges are in the box?

